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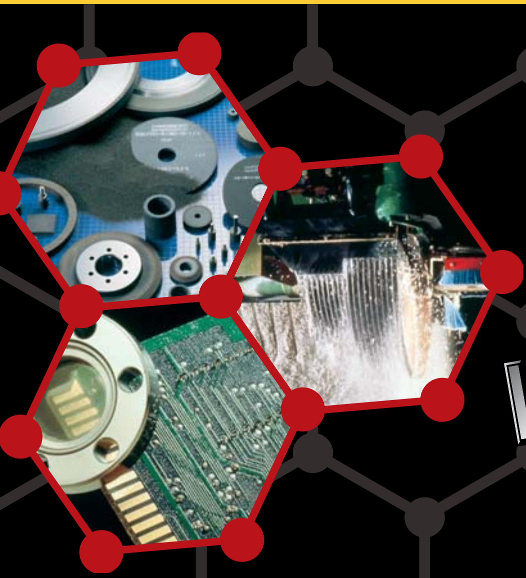

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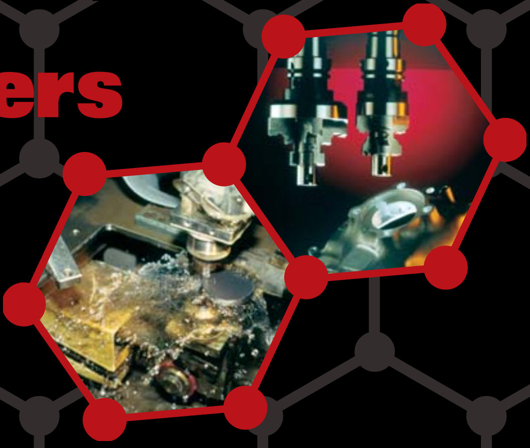

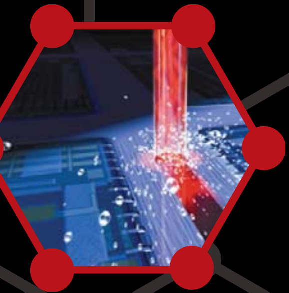

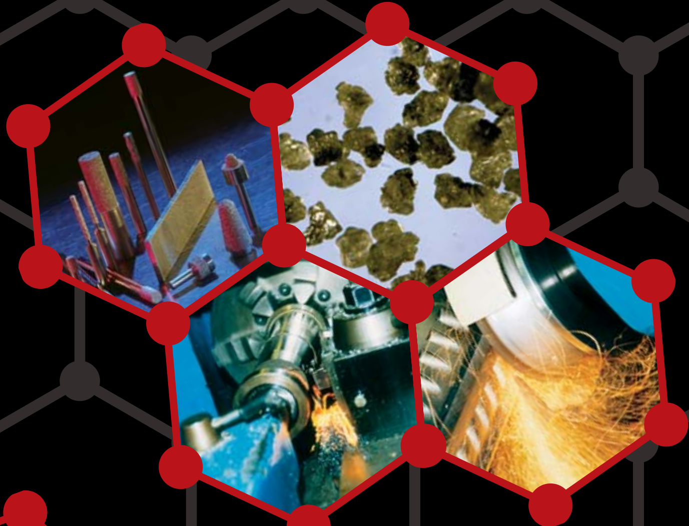

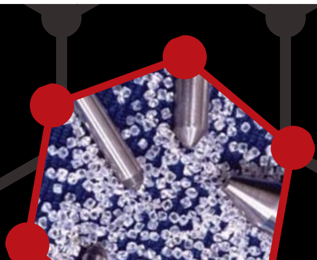

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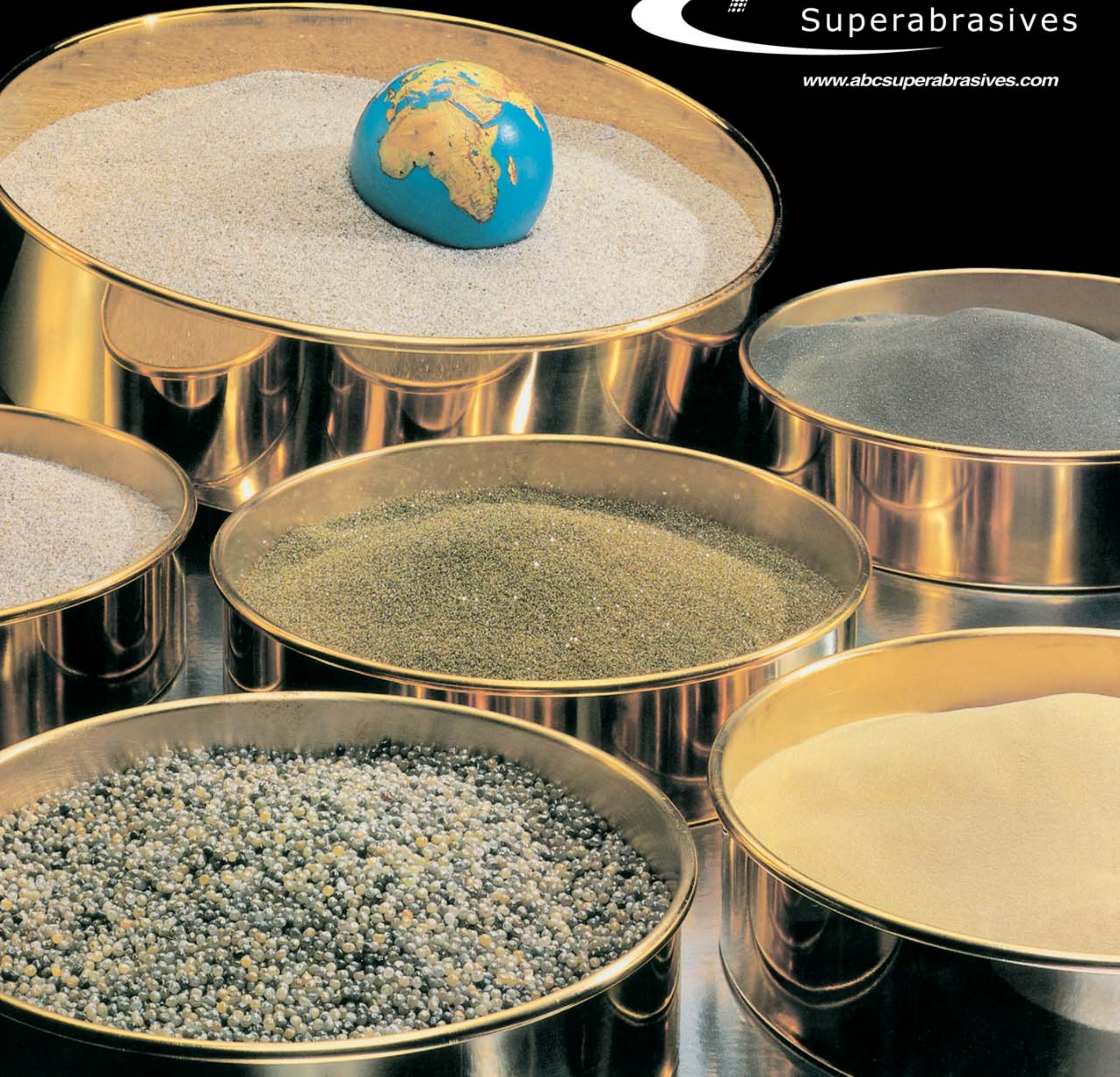

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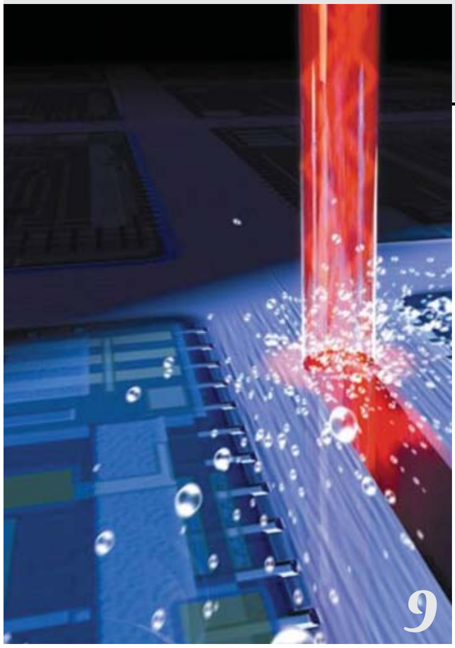

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FINER POINTS is the only publication devoted exclusively to the understanding, selection and application of diamond, cubic boron nitride and related materials. It is edited for recipients who are involved in some way with these "superabrasives", either as providers of the materials, producers of products containing the materials or users of these products (e.g., grinding wheels, dressing tools, drill bits, saw blades, sawing wires, cutting tools, polishing compounds, CVD film products, etc.).

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A Finer Point of View…

INTERTECH 2008 will be held on May 5-7, 2008 at the Contemporary Resort in the beautiful, family friendly Orlando, Florida USA. INTERTECH 2008 will once again have global leaders in research, superabrasive synthesis, manufacturing, application development and end users of superabrasives presenting papers and attending the conference. The last INTERTECH held in Atlanta, GA featured approximately 60 excellent papers selected from over 100 submitted abstracts on ultra hard technology. INTERTECH 2006 hosted attendees from 19 different countries and 5 continents making this a true global event! Attendees were ecstatic about the format and content and most expressed their eagerness to return in 2008. INTERTECH 2008 is responding to that huge success with an early flood of papers, new companies wanting to present papers as well as a newly structured INTERTECH 2008 steering committee comprised of current IDA Directors, global manufacturers, academia, leading abrasive manufacturers and the heads of major grinding and machining organizations. INTERTECH 2008 is an international conference designed to celebrate the awesome growth of diamond and other ultra hard technology and to show how this technology is integral to many of the processes that produce the products vital to society. Without diamonds and related materials, many of the things we take for granted, such as petroleum, minerals, industrial products, automobiles, aircraft, electrical components, stone, highways, glass, wire & cable, wood composites…even special surgical knives and prosthetics, would be vastly different, more costly or not available at all. Superabrasives are the heart of achieving success in all these areas and many more. Leading manufacturers and service providers have made a major commitment to the use of Superabrasives in their processes and applications. New workpiece materials and an increased demand for productivity have heralded the need for Superabrasives in every application possible. Machine tools are now being designed to take full advantage of Superabrasive cutting tools, wheels and blades…and this is just the beginning. Application of "Superabrasives" has grown from the first use of natural diamond to grind tungsten carbide in the early 1940's to a broad range of high production applications across many manufacturing and service industries. From grinding and machining of superalloys and high-tech ceramics in Aerospace to metalworking of hardened steel, bi-metals or metal matrix composites in Automotive, as well as, the sawing or drilling of stone and concrete or new CVD diamond innovations, the "Superabrasives" industry has made great strides by increasing productivity, reducing manufacturing & operating costs and implementing new technology. INTERTECH 2008 is an outstanding platform to share your expertise in new technology or innovative application developments. Presenters are featured here and gain notoriety and exposure for research, products and use. Now is the time to get on the program by submitting an abstract for your paper. Remember, only the best will be accepted. Do not be left behind, attend INTERTECH 2008 and see what is going on in your industry, meet the people and innovators of superabrasives or come and learn where you can improve your operations by advancement into superabrasives. Book your flights, bring your family to Disney and share in a unique experience. Come learn about Superabrasives and interact with global leaders all with one visit… INTERTECH 2008.

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Guest Editorial

By Dr. Julie Miller

E-Mail Protocol

The blessing and the curse of the digital revolution! Between e-mail, instant and text messaging, cell phones, Blackberries and the Internet, we are drowning in data overload. Moreover, the constant interruptions cost the U. S. economy an estimated $558 billion annually. This staggering number does not add in the cost of poorly written e-mails that land companies and employees in hot legal trouble, destroy long-term client relationships, and ruin reputations-just review Mike Brown's e-mails (former FEMA chief) as Hurricane Katrina raged and you will understand. Add to this mix a lack of civility and common sense and you have an explosive brew.

What to do? For starters, treat e-mail writing as writing not as casual conversation. Whether words are written in the sky, sent by carrier pigeon or via the Web, words must connect with the reader. Good writing allows this to happen; poor writing does not. Currently, writing online is still, as author Patricia O'Conner writes, in its Wild West stage ... with everybody shooting from the hip and no sheriff in sight. Therefore, establish some law and order by developing an e-mail protocol, whether you are a multi-national or a single shingle firm. Simply stated it's "the way we do business around here" in terms of communicating via e-mail with co-workers and customers. It is a code of behavior, a set of standards as to how you will frame your words, manage your inbox, even extend your brand. Below is a short list of questions to visit at your next meeting. Your answers could be the beginning of a company-wide document.

How do you greet and close messages? Companies are putting together a series of key phrases used solely for openings and closings. Remember, you would never call without greeting someone. Why would you not in your e-mails?

What does your e-mail signature say about your company? It should be an extension of your company's brand. Professional with no cutesy sayings, it should contain all contact information. Establish a standard for font style and size. Also, because you have limited real estate, consider placing your signature block horizontal rather than vertical.

What is the company policy around blind copies? Some companies only use them for e-blasts; others say they are strictly verboten. Discuss why, when and how you use them. Caution: Some computer programs allow all those who you do not want to see your e-mail to view it if the recipient hits "reply all."

Do you have a message for the out of office auto-responder and when do you turn it on? Four hours? One day? A large bank requires if an employee is immersed in an important project, it must be turned on if he/she is gone from the office for more than one hour.

DR. JULIE MILLER

How often do you check e-mails? Some companies set their programs so e-mails are only called up hourly, thus reducing down time and increasing productivity.

How soon do you return e-mails? Within four hours? 24 hours? Some company policies state all e-mails need answering within the same business day.

Do you use emoticons? Buzzing bees, dancing bears, smiley faces. Suggestion: Heartily rule against it.

How many e-mails before you pick up the phone? The rule of thumb seems to be three. If the issues are not resolved, pick up the phone or walk down the hall.

What is your company's policy about writing business letters, accessing confidential information, or handling racial or sexual harassment? Your e-mail policy should be compatible with these documents.

How will you insure employees understand your protocol? For example, who is the contact person when questions arise? How will updates be handled? Will you schedule trainings?

E-mail has become the biggest productivity drain in businesses today. Getting a handle on this daily data dump by establishing procedures, etiquette if you will, will make you and your company stand above the crowd and possibly bring law and order to the untamed world of Internet communication. What are your "best practices"?

About the Author:

Dr. Julie Miller, founder of Business Writing That Counts, is a national consultant and trainer who helps professionals reduce their writing time while still producing powerful documents. For more information visit www.businesswritingthatcounts.com

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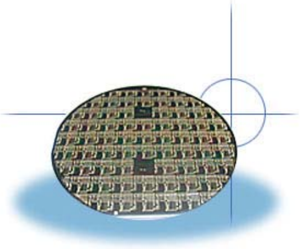
NEWS and notes

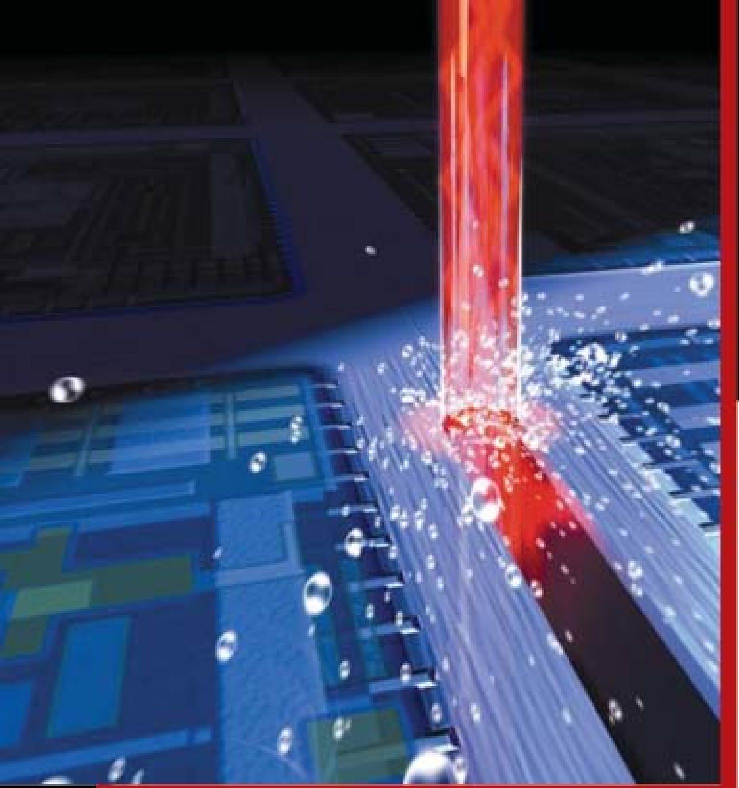
WHEELING, IL – ENGIS CORPORATION, HAS ANNOUNCED THE PROMOTION OF JOHN SMALLSHAW TO THE POSITION OF VICE PRESIDENT SALES. In his new position, Smallshaw will oversee sales and marketing operations for the entire Engis product offering. This includes Hyprez® flat lapping/polishing systems and Hyprez diamond products, Engis single-pass bore finishing systems, Electrogrip® diamond-plated cutting tools, Hyprez Diamold mold and die finishing products, and the Hyprez Microtech line of microfinishing systems for advanced materials. "John Smallshaw has been a key member of the Engis management team over the past several years in his roles as general sales manager, Hyprez product manager and regional sales manager," remarked Stephen Griffin, president of Engis Corporation. Griffin added, "We look forward to John joining the Executive Management Team and using his sales & marketing experience to help the company achieve its growth goals." For more information, contact Engis Corporation, Telephone: 847-808-9400. Web: www.engis.com



SIMI VALLEY, CALIFORNIA - AUGUST 2007 - VIEW MICRO-METROLOGY, THE MERGER OF VIEW ENGINEERING AND MICRO-METRIC, is dedicated to providing dimensional metrology systems to the scientific, electronics, and micro-fabrication industries, which are adopting micro-scale processing technologies in their manufacturing. Micro-Metric provides ultra-high precision non-contact measurement systems for wafer, slider and photomask process control. VIEW Engineering provides high-speed, high accuracy measurement systems for micro-components of assemblies. With collaborative engineering and technical support, VIEW Micro-Metrology is better able to serve global customers, developing application-specific software and hardware to meet manufacturers' evolving metrology needs. For further information visit: www.viewmm.com.

CONCRETE CUTTING INDUSTRY ASSOCIATION OF AUSTRALIA CHANGES NAME TO CONCRETE SAWING & DRILLING ASSOCIATION AUSTRALIA (CSDAA). A Special General Meeting was held for the purpose of recommending to members that the name of the Association be changed to Concrete Sawing & Drilling Association Australia. A new logo was also introduced as shown.

WALL COLMONOY ANNOUNCES THE APPOINTMENT OF AMI ZELCER TO THE POSITION OF GENERAL MANAGER, WCC OHIO AEROSPACE GROUP. Zelcer will have responsibility for the overall administration and management of the business units in Cincinnati and Dayton. Zelcer has more than twenty years experience in the aerospace industry; having served as general and operations manager, engineering and business-development manager, and head of quality control for suppliers of major components for the aircraft industry. Zelcer received his Master's in engineering from Ohio State University.For further information visit: www.wallcolmonoy.com



WATER-JET-GUIDED LASER PROCESS FOR CUTTING OF CBN AND PCD INSERTS

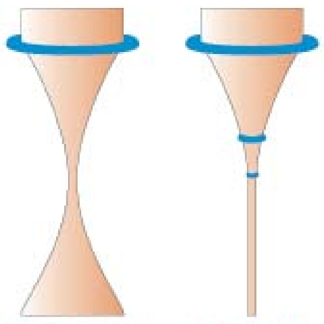
By: ROY HOUSH, Synova SA, Ecublens, Switzerland

Cutting Of Diamond And CBN Inserts Difficult Process

Photo 1- CUTTING TOOL WITH INSERTS

PCD and CBN are commonly used as inserts (*Photo 1*) in machine tools for high-speed cutting, milling or turning machines because of their exceptional tool life. However, because of their hardness, it is difficult to cut the different shapes of the inserts (typically triangles, rectangles or lozenges) from larger discs or plates.

During this manufacturing step, several important requirements should be taken into consideration. The edges have to be smooth and parallel, and the cutting kerfs narrow in order to lose as little material as possible. Burrs should be avoided, as well as material changes due to heating. Speed is also an important criterion as cutting hard materials can be time-consuming, especially for important thicknesses (typically between 1 and 4 mm). Cutting hard materials with diamond saws is problematic because of the important tool wear and the slowness of the process. Thin gaps cannot be obtained, resulting in costly material loss. Moreover, only straight cuts can be made. EDM cannot be used if the material is not electrically conductive and it is a very slow process. Conventional lasers are a possible solution, but the process generates particles and thermal damages that have to be removed with post-processing steps. Furthermore, conventionally focused lasers produce conical kerfs. If conventional lasers can be used for CBN drilling in some cases, cutting is still very problematic. A new alternative is the use of the water-jet-guided laser technology, a revolutionary technology combining a low-pressure, and hair-thin water jet with a laser beam. So Conventional Water Jet basically, in conventional laser cutting, the laser beam must be focused on the insert, resulting in a conical shape beam and V-shape kerfs. The insert absorbs the laser beam, which heats the material until melting and vaporization occur. The molten material is expelled from the cut using an assist gas, coaxial to the laser beam; the gas is not very efficient due to the low kinetic energy and a significant amount of resolidified materials remain inside the cut. Water-jet-guided laser technology uses a low-pressure water jet to guide the laser beam and generates parallel kerfs by means of total internal reflection at the insert /air interface. During ablation, the water jet expels most of the molten material (high kinetic energy). Only a tiny amount of resolidified materials remain.



INNOVATIVE TECHNOLOGY A MOST PROMISING TOOL FOR HARD-MATERIAL CUTTING

Cutting of hard materials, for example cubic boron nitride (CBN) and polycrystalline diamond (PCD), is a highrequirement process; among the existing techniques, very few are efficient. The new water-jet-guided laser technology has been improved over the years to complete such a delicate operation. The reached cutting speeds are higher than for most processes. No post-processing steps are required to clean the inserts after cutting, as the level of contamination directly after cutting is very low and since heat influence is negligible.

Thanks to the particularities of the Laser MicroJet, the cut is parallel and very regular. This innovative technology, able to cut any material, providing that its absorption coefficient at the laser's wavelength is sufficient, is today the most promising tool for hard-material cutting.

Water-Jet-Guided Laser System Best Of Two Worlds

The water-jet-guided laser technology, also called Laser MicroJet, is innovative in the sense that the laser beam is not directly focused on the work piece, as for conventional laser systems, but guided inside a water jet by means of total internal reflection at the water/air interface, similarly to conventional glass fibers (see *Figure 1*, *Photo 3*). The use of a low-pressure, hair-thin water jet makes this technology completely different from other laser-based technologies. Indeed, besides its primary guiding function, the water jet has two major effects that are paramount for precision cutting. First, the water jet removes most of the particles generated by laser ablation. As a thin water film is generated on the work-piece surface during cutting, contamination is negligible. In second place, the heat-affected zone is extremely thin, since the continuous water jet cools the work piece between the laser pulses.

Another important effect of the water-jet guiding is to generate parallel kerfs, since the cylindrical water jet guides the laser energy down to the bottom of the cut; the conical effect present in conventional laser cutting is avoided. In addition, very narrow kerf widths are possible due to the use of small nozzles.

For this particular application, a common jet diameter is 36 µm. Powerful lasers near their maximum intensity (high peak powers) are preferably used because of the temperature stability of these materials and the thickness of the inserts; it is also important to use pulsed lasers with high pulse repetition rates, as the edge quality is improved.

Polycrystalline Diamond Structure And Processing

Polycrystalline Diamond (PCD) is a synthetic diamond, exceptionally resistant to wear, used in a wide range of machining operations. Usually, the PCD diamond layer is bonded to a tungsten carbide (WC) substrate, which provides strength and a brazable base for bonding to other metals. During insert production, both layers need to be completely cut. The water-jet-guided laser performs this operation with excellent quality and reasonable cutting speed, considering the thickness of the pieces that have to be cut: Thin samples (1.1 mm WC and 0.5 mm PCD): cutting speed 10.9 mm/min Thick samples (2.7 mm WC and 0.7 mm PCD): cutting speed 8 mm/min Using Q-switched lasers (*Photo 4*) instead of long pulses, the cut quality was greatly improved, as almost no contamination was visible on the surface of the processed samples; furthermore, these frequency-doubled lasers (wavelength: 532 nm) achieve higher cutting speed than infrared lasers. High peak power is advantageous; a good way to increase the beam power per surface unit is to reduce the water jet diameter, that is, the nozzle diameter. With Q-switch lasers, the use of 40-µm nozzles (generating a 36-µm water jet) achieves a good average speed.

The microscope images below (Photo 5a & 5b) show a triangle insert with PCD on the front side and WC on the backside (total thickness: 1.6 mm). A Q-switch green laser (wavelength: 532 nm, average power: 150 W) was coupled into a 72-µm water jet. The WC layer was cut first and is referred to as "front side". For through cut, a total processing speed of 12.8 mm/min was reached in 70 passes. The resulting edge quality is very good; no heat-affected zone can be seen in the area surrounding the cut. The cut is free of burrs and the contamination is very low.

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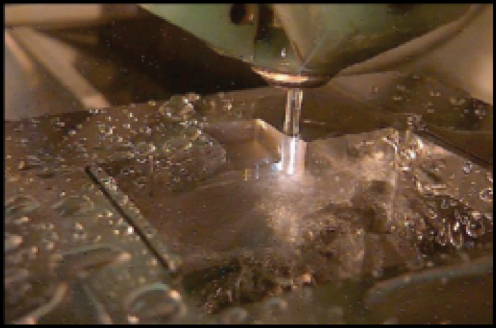

Photo 2 - ELECTRICAL DISCHARGE MACHINING

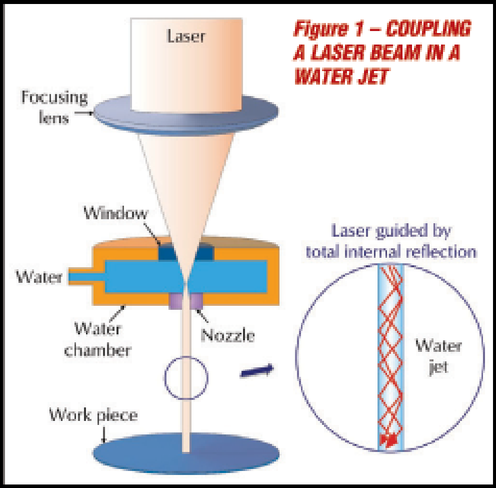

Figure 1 – COUPLING A LASER BEAM IN A WATER JET

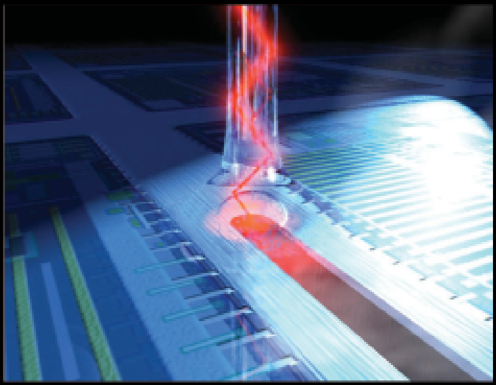

Photo 3 - LASER BEAM IN A WATER JET

Photo 4 – MULTIMODE Q-SWITCHED LASERS

- ***Wavelengths: 1064 nm (infrared), 532 nm (green) or 366 nm (UV)***
- ***Average power: up to 200 W***

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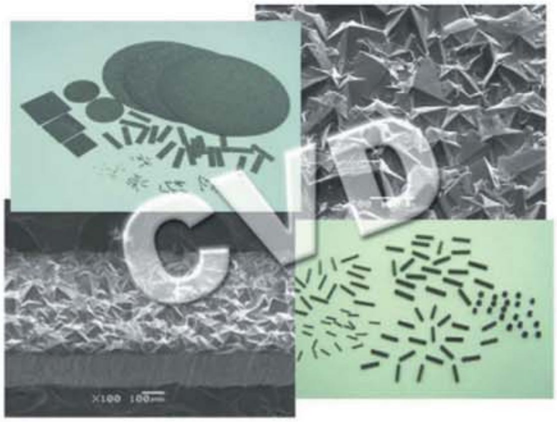

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November 13-15, 2007
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December 5-8, 2007
Machine Tools Indonesia 2007
Jakarta International Expo
Jakarta, Indonesia
www.allworldexhibitions.com/metal

CALENDAR EVENTS for 2008

January 21-25, 2008
World of Concrete 2008
Las Vegas Convention Center
Las Vegas, NV
http://www.worldofconcrete.com

MAY 3-4, 2008
Industrial Diamond Association of America
Annual Meeting
The Contemporary Resort
Orlando, Florida USA
www.superabrasives.org

INTERTECH 2008
An International Technical Conference on Diamond, Cubic Boron Nitride and their applications.
www.intertechconference.com
THE CONTEMPORARY RESORT ORLANDO, FLORIDA USA May 5-7, 2008

MAY 5-7, 2008
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Orlando, Florida USA
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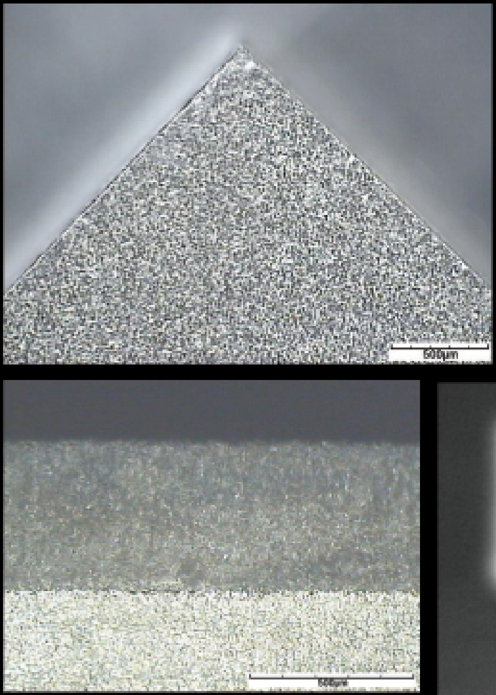
Photo 5a & 5b – SAMPLE COMPLETELY CUT WITH THE LASER MICROJET: PCD on front side, corner of the triangle (first picture) and side cut showing PCD on top and WC below (second picture)



Water-jet-guided laser technology has been improved over the years to complete the delicate operation of cutting hard materials.

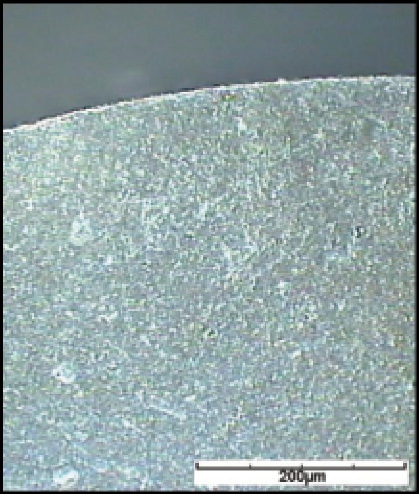


Photo 6 – EDGE OF A CBN CYLINDER (diameter: 3mm) directly after cutting with the Laser Microjet

Polycrystalline Cubic Boron Nitride Structure And Processing

Cubic boron nitride (CBN) is a synthesized material, stable under conditions of high temperature, which is the second hardest material behind diamond. CBN inserts are used for machining hard materials, providing significant improvement in productivity. The microscope image below (*Photo* 6) shows the edge of a cylinder made in hard CBN on top of a WC-Co layer (total thickness: 1.6 mm) directly after cutting with the water-jet-guided laser (no post-processing). The laser used for this application was also a green laser (wavelength: 532 nm, average power: 60 W) coupled in a 48-µm water jet. The overall cutting speed was 9 mm/min, achieved in 100 passes. The edge is very clean and extremely sharp. Even at high speed, the cut remains smooth. The contamination level on the surface of the insert is minimal. ■

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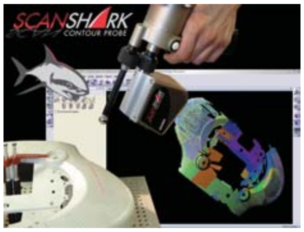

September 2007, Wixom, MI – A new-to-the-market inspection and reverse engineering system. The mobile metrology system delivers the power of articulated arm measurement and laser scanning for on-demand part inspection and/or reverse engineering right on the shop floor. The ROMER ScanShark is particularly effective for part surfaces that are difficult to reach, such as inside an aircraft or underneath an automobile. ROMER's suite of portable measurement products are used worldwide by the automotive, aerospace, heavy machinery, and general engineering and manufacturing industries. The ScanShark product line is designed to help control the quality of parts, tooling and assemblies during every phase of manufacturing. With precision scanning and probing capabilities, operators can identify errors or deviations in the production process, inspect first assembled parts, check tool wear and part quality, and perform final part verification.. **For further information visit: http://us.romer.com**

THE NEW ABB FLASHDROP IS A POWERFUL PALM-SIZED TOOL FOR FAST AND EASY PARAMETER SELECTION AND SETTING

August 2007, New Berlin, WI – The tool can copy parameters between two identical drives, or between a PC and a drive, making it ideal for high-volume customization of machines. With the FlashDrop (MFDT-01) tool, the drive doesn't need to be unpackaged, or connected to the mains. "Simply open the top of the box and seat the FlashDrop wand into the access point built into the ABB Low Voltage drives, and they are programmed in as little as three seconds," notes Michael Mikolajczak, product line manager for ABB's ACS50, ACS150, ACS350 and ACS/H550 drive lines. "And, for distributors, machine builders and system integrators who need identical programming across a host of drives for machine production or repeatable processes, this tool ensures exact replication of programming – and minimizes the labor/costs required to achieve it," he said. "The tool makes it easy to achieve very fast, exactly repeated production, and removes the variation that can affect an OEM's potential quality issue related to varied programming across hundreds, or even thousands, of units," said Mikolajczak.

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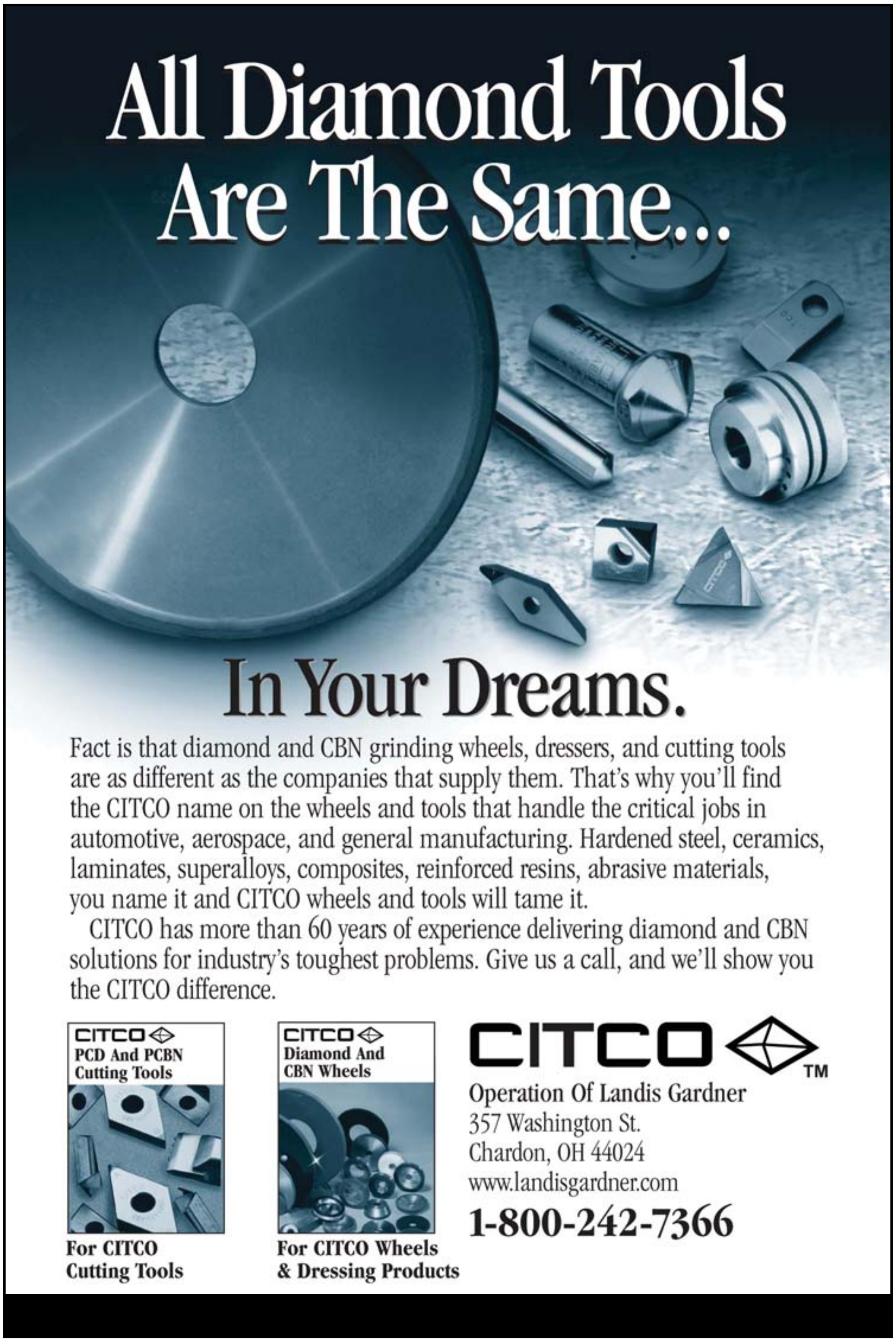
September 2007, Azusa, CA – The art and science of computer forensics – capturing images from "erased" drives, reconstructing files, etc. – doesn't always happen in a "CSI" laboratory. Sometimes it happens at the site where the computer is located. ACME portables are real-life tested, proven effective in most demanding environments, excelling in critical data acquisition from "erased" drives or reconstructing files for telecommunications, industrial, manufacturing, medical, onboard flight-line aerospace applications and other. The company manufactures a broad line of rugged computers, workstations, laptop and lunchbox portables, to meet computing needs of extreme environments whether they are in aerospace or on an industrial plant floor. **For additional information visit: http://www.acmeportable.com.**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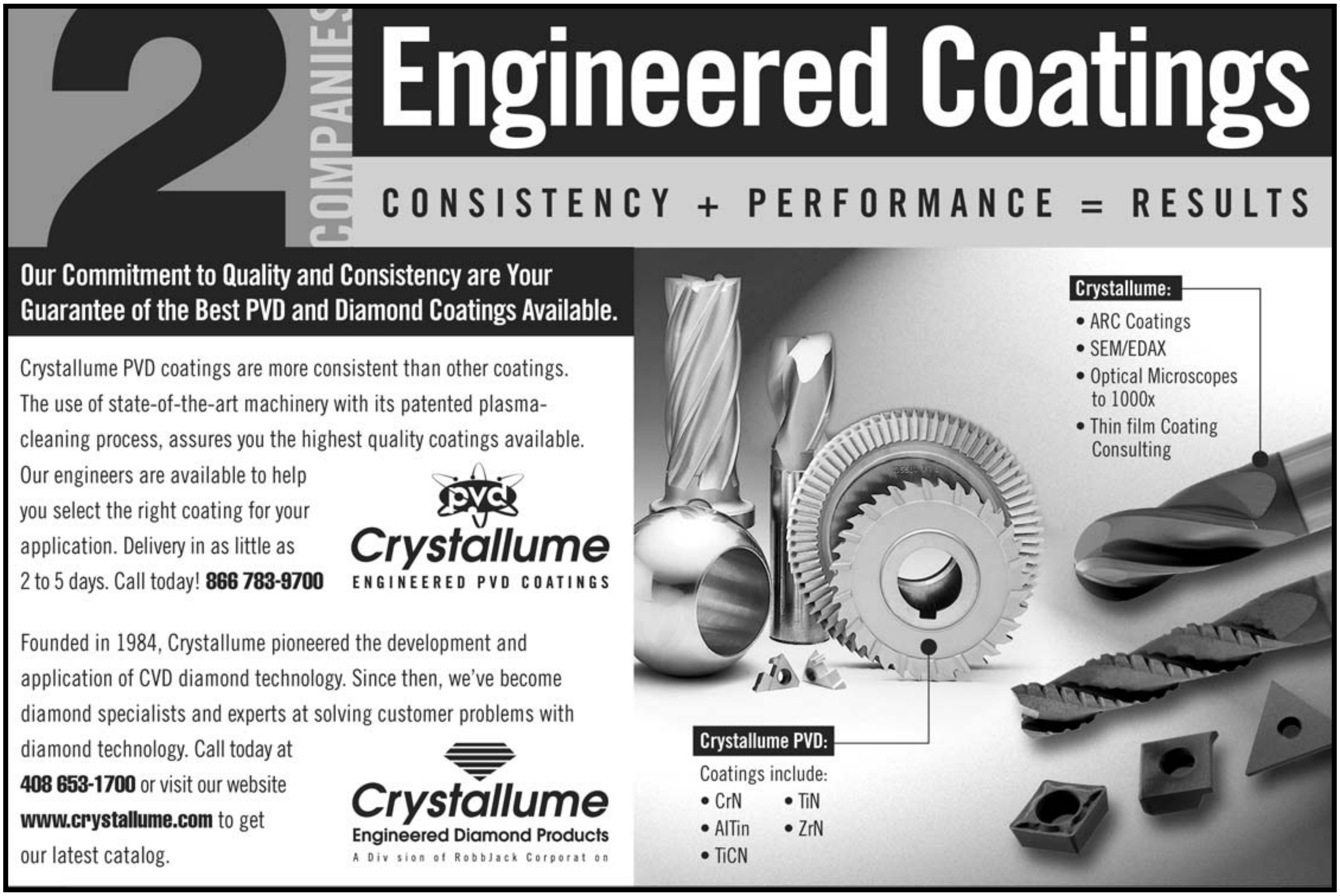

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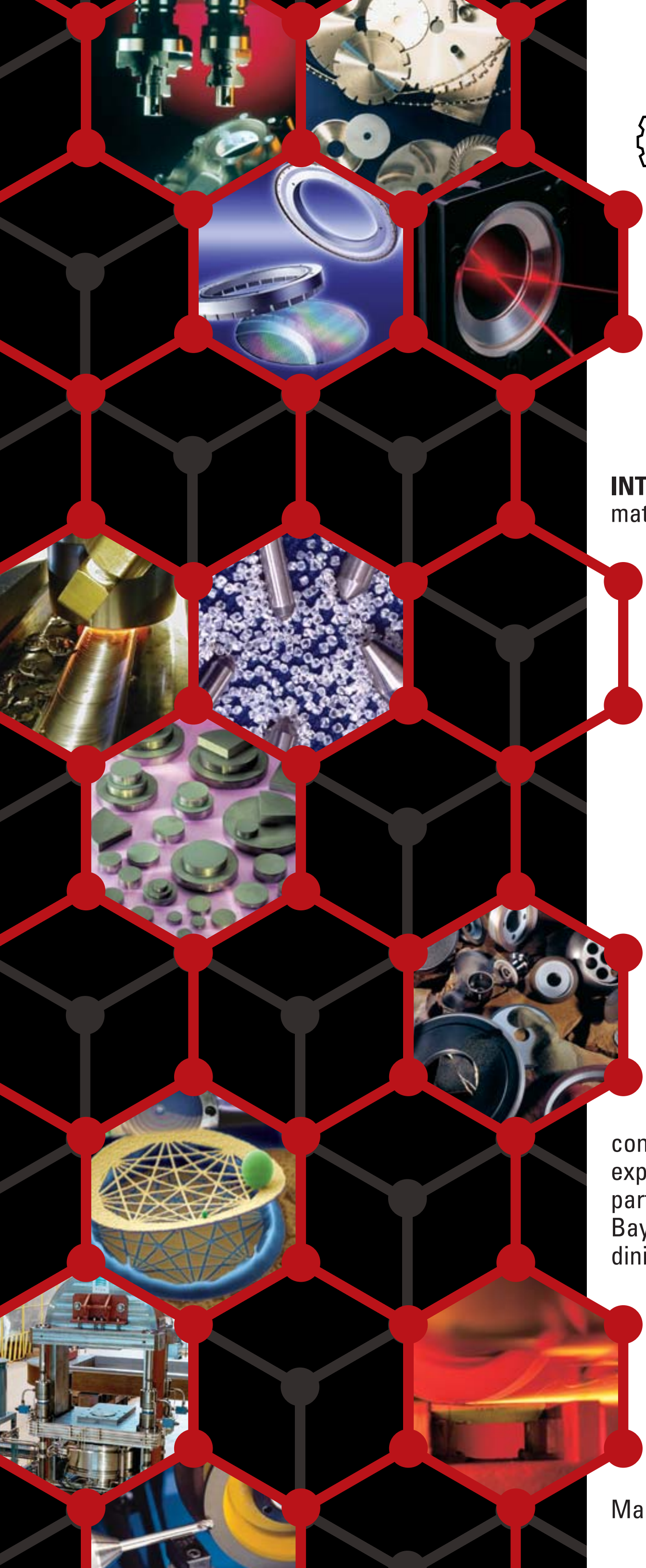

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THE CONTEMPORARY RESORT
ORLANDO, FLORIDA USA
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INTERTECH 2008 is an International Conference featuring presentations on new and evolving technology for superabrasive materials and how these materials are applied in various industries. **INTERTECH 2008** promises to be the most comprehensive commercial and technical conference ever held on industrial diamond, cubic boron nitride, polycrystallines, CVD diamond and other related superabrasives. **INTERTECH 2008** will feature leading experts representing international Suppliers, Research Facilities, Academia, End-users, Machine Tool Builders and the Scientific Community. They will be presenting papers on subjects that will introduce new technology on superabrasives. This will be an international "meeting of the minds" for every aspect of application and new product development. Whether it's improved crystals and polycrystalline materials or new inroads for natural and CVD Diamond, this conference covers the complete spectrum. From prosthetics or diamond knives in medical to texturing of computer discs, diamond and other "superabrasives" are changing the world in which we live.

See the **INTERTECH 2008** website: www.intertechconference.com for additional information on

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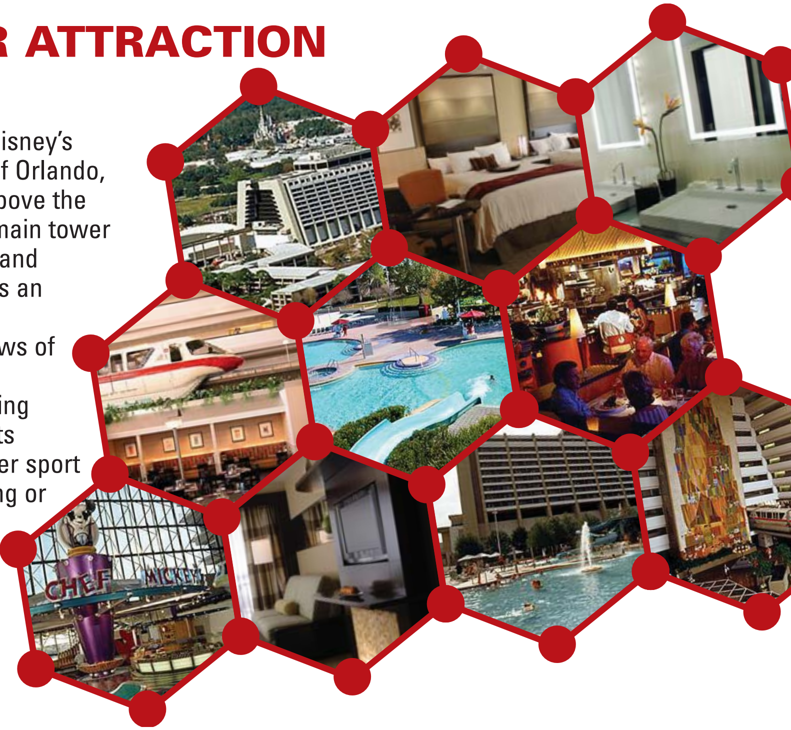
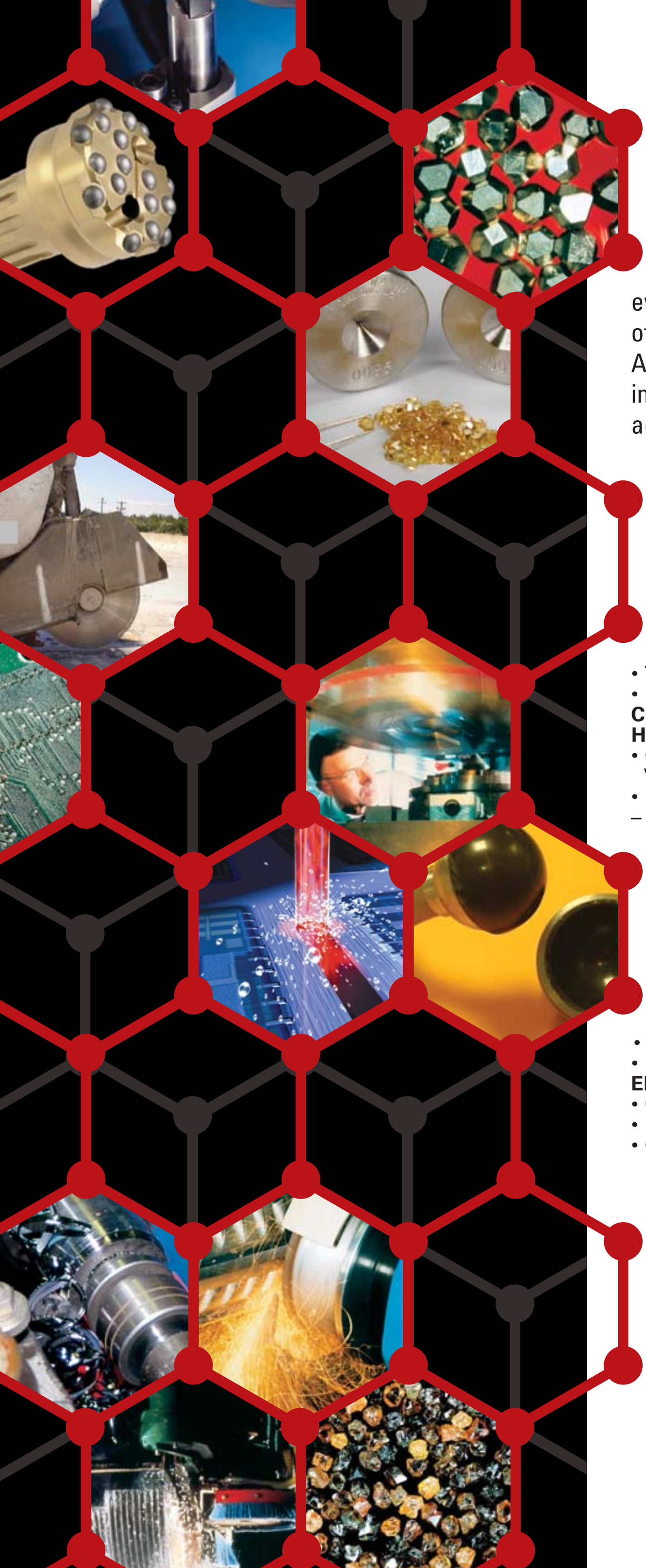
EXCITING VENUE A MAJOR ATTRACTION FOR INTERTECH 2008



This spectacular event will be held from May 5-7, 2008 at Disney's Contemporary Resort in the exciting and entertaining city of Orlando, Florida USA. The Contemporary Resort rises majestically above the nearby Magic Kingdom Park. From the dramatic art in the main tower with sleek monorails cruising overhead to the casual style and convenience of Garden Rooms looking out over the beach, this is an experience not to be missed. After a day filled with conference participation, attendees can relax and enjoy the spectacular views of Bay Lake, the Magic Kingdom Park and Seven Seas Lagoon. For dining excitement ahead of its time, experience the award-winning California Grill where entrees change seasonally and guests enjoy an on-stage kitchen. You have to experience the water sport activities from watercraft rentals to water-skiing, parasailing or fishing excursions. All these amenities add to **INTERTECH 2008**, to make it an overall "have to attend" experience. We already have some outstanding events planned to make this not only a rewarding technical experience, but also an enjoyable trip you will remember for quite a while! Make plans now for May 5, 6 & 7, 2008!



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Wear Resistance Of Diamond Dependant On Orientation And Application To Improve Dresser

By: Takaru Nakashima, Engineering Manager Sumitomo Electric Hardmetal Corp. Hyogo, Japan

Photo 1 – Dressing of Al_2O_3 Wheel

Diamond Wear Resistance Heavily Depends on Crystal Orientation

Diamond is the hardest material; therefore it is the most wear resistant material. Utilizing this property diamond is used for wire drawing die, cutting bite, dresser, etc. However wear resistance heavily depends on crystal orientation. This anisotropic feature usually has a negative influence on the applications to wire drawing die (anisotropic wear) and cutting bite (orientation constrains in shape-forming). In contrast, for some applications like a dresser, they can be designed for excellent performance in wear resistance once proper orientation of diamond crystal is selected. Therefore it is necessary to understand orientation dependence on wear resistance to elicit

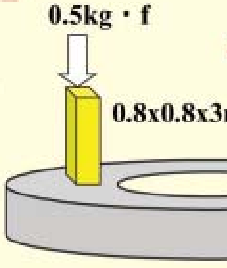

Figure 1 – Grinding Setup

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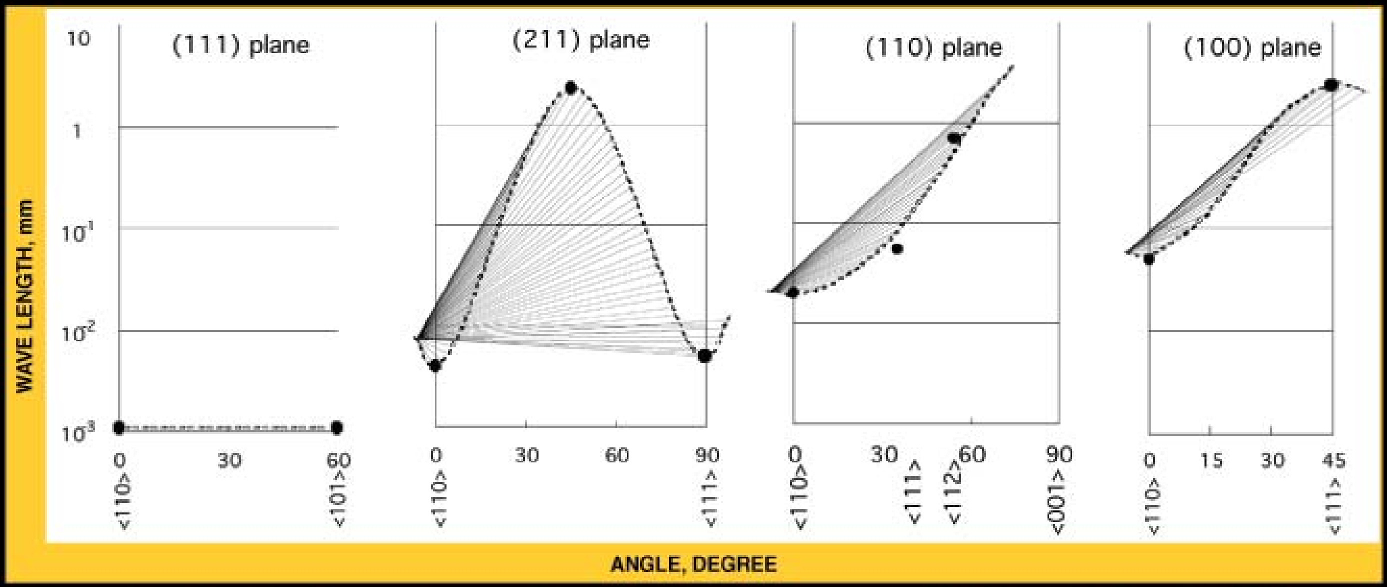

Figure - Angular dependences of wear resistance of synthetic diamond on (111), (211), (110) and (100) planes.

highest performance from diamond. In the past, there were many works to measure wear resistance of diamond crystal. All of these works were done using natural diamond, of which crystalline quality and amount of impurity varied from stone to stone.

In addition, grinding conditions in the previous works were much different from those when diamond is used as dresser. At that point, diamond was polished with micron powder of diamond on skive disk, while, diamond dresser is used for dressing, tooling and forming of GC (green Carborundum), WA (white alundum) or CBN (cubic boron nitride) grinding wheel (*See Photo 1*). Wear resistance of synthetic diamond was measured quantitatively in terms of orientation dependence. Wear resistance test was done by

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grinding with diamond wheel. This grinding condition was close to the one for real application of diamond dresser. Based on the experimental results a new design of diamond dresser is proposed. Comparisons of performance between the new design and conventional dresser were carried out in regard to wear rate and stability. Comparison of dresser performance between single crystal diamond and CVD diamond was is also reported.

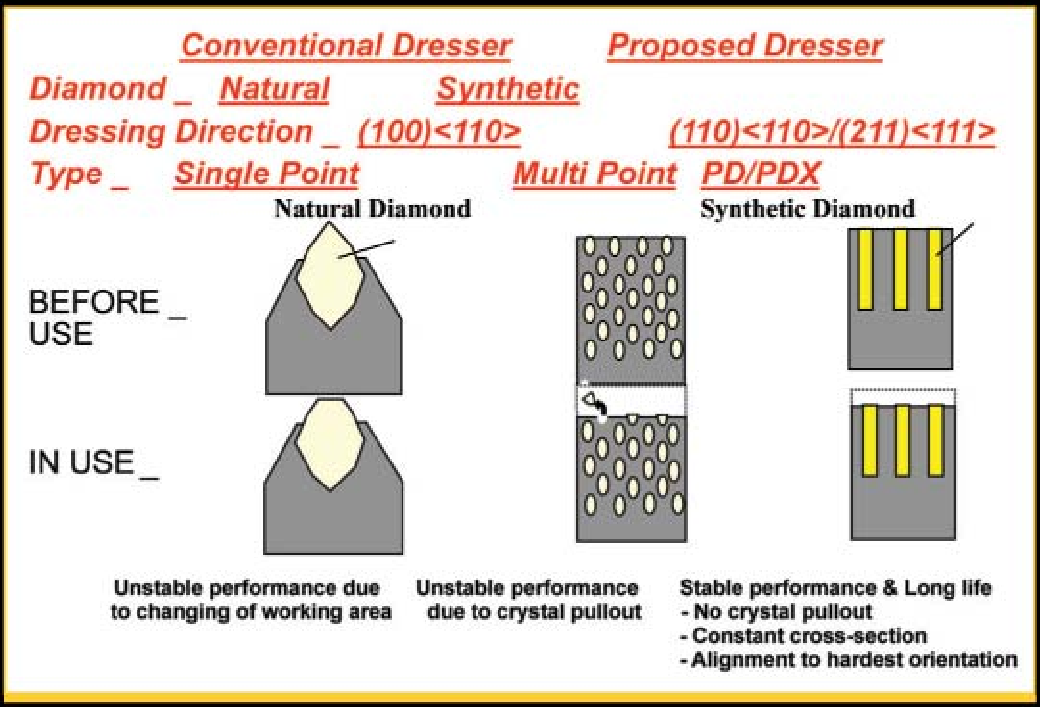

Figure 3 - Comparison of conventional and new designed dresser

Measurement of Wear Resistance

Rectangular solids (0.8x0.8x3.0 mm3) with end face of (100), (110), (211) and (111) plane were prepared using synthetic diamond. Each solid was ground with an 800-mesh metal-bond diamond wheel with a wheel speed of 50m/sec under dry condition for 2 minutes (*Figure 1*). Pressing load was 0.5kgf. To prevent initial chippings or a lack of uniform wear, some pre-dressing on the testing surface was accomplished to make it smooth. Wear length was measured after grinding for each plane changing dressing direction on the plane. For reference, "(110) <110>" denotes <110> direction on (110) plane for convenience. Comparisons of wear volume in various directions on each plane are shown in figure 2. The results were almost consistent with the previous works. However, it was noted that wear resistance of (110) <110> was better than (100) <110> in the present work, while, the results were opposite in the previous works. The reason was not well explained, but it could be possible that this difference was due to the difference of crystals used for experiments (synthetic/natural diamond) or due to the difference of grinding conditions between the present work and the previous ones. This time wear resistance of (211) plane was measured for the first time. We found that wear resistance on (211) <110> and (211) <110> are then highest next to (111) plane.

> ***Diamond is the hardest material; therefore it is the most wear resistant material. However wear resistance heavily depends on crystal orientation.***

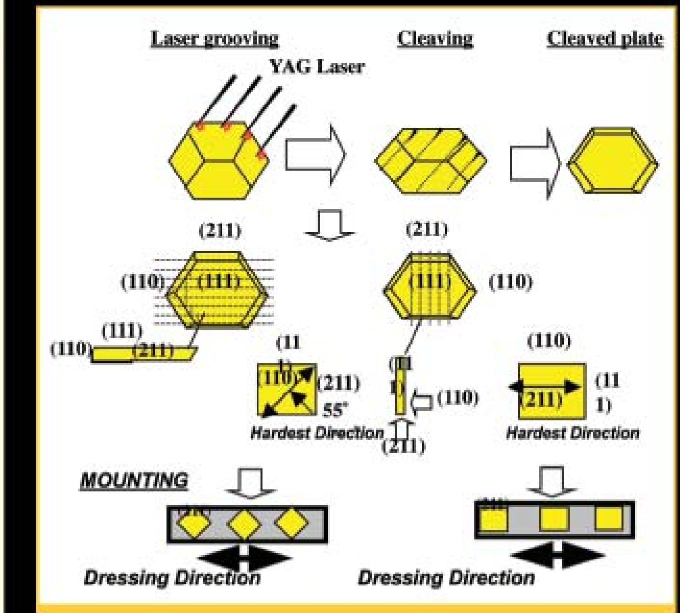

Figure 4 - Production process of new designed diamond dresser. (Left side: PD type and right side: PDX type)

Dresser Diamond and Optimal Directions

Conventional dressers are shown in figure 3. Natural diamond is commonly used for conventional dressers and its dressing direction is usually (100) <110>. According to experiments (100) <110> is not the best direction. In addition, working area varies as wear progresses because of octahedral shape of natural diamond in single point type or crystal pullout during use in multi point type. This means that dressing performance of conventional dresser is

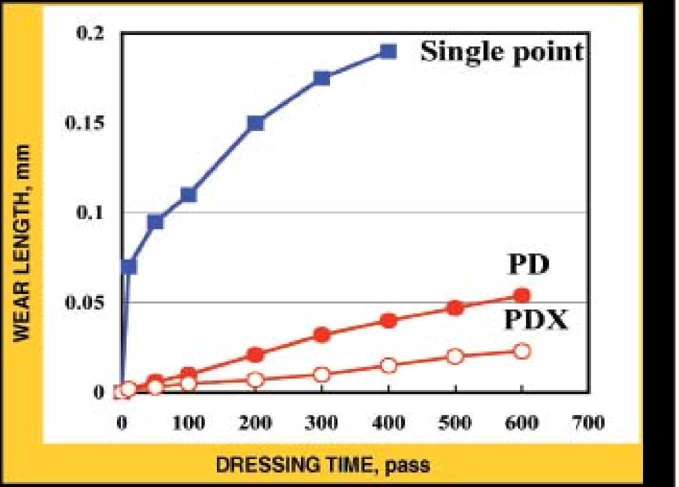

Figure 5 - Comparison of wear length between single point dresser, PD and PDX type dresser.

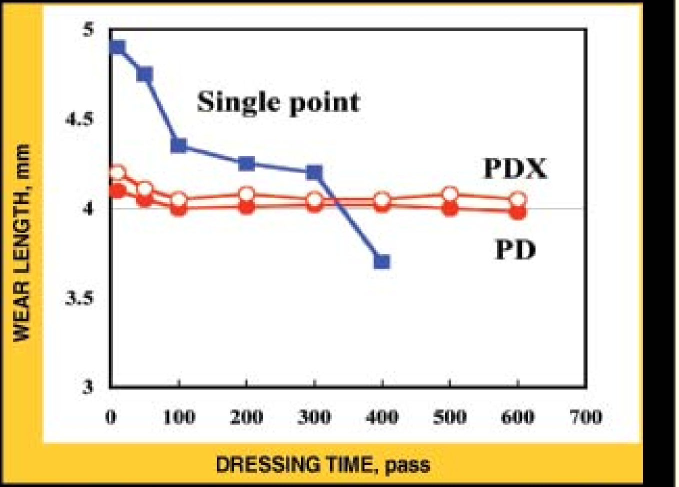

Figure 6 - Comparison of surface roughness of grinding wheel between single point dresser, PD & PDX type dresser.

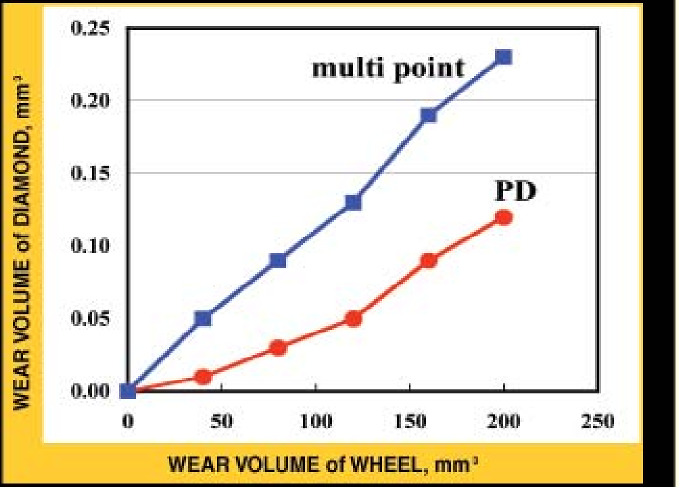

Figure 7 - Comparison of wear volume between single point dresser and PD type dresser.

unstable both in single point and multi point. To solve these problems we proposed new type of diamond dresser and also developed the process for preparation of new designed diamond dresser. Proposed dresser was quite different from conventional ones as regards diamond crystal alignment and shape of crystal.

Diamond Crystal Alignment and Shape for Best Performance

From the experimental results, (111) <110> or (111) <100> have the best wear resistance. However, (111) plane is not suitable as contact area because diamond crystal is easily cleaved parallel to (111) plane under repeated load. Therefore (110) <110>, (211) <111>, or (211) <110> are preferable for dresser. These directions are expected to have higher dressing performance than conventional (100) <110> direction. Stick shape diamond was adopted so that dresser with constant cross-section area and free from crystal pullout during use can be obtained. Production process of the new type dresser is shown in figure 4. Utilizing of cleavability of crystal can reduce the process cost of stick shaped diamond. Cleaved plate was just need to be cut into sticks by LASER horizontally or vertically to obtain diamond sticks with the end faces of wear resistant plane [(110) or (211)]. In addition, since the ridge lines of crystal on synthetic diamond is much more visible than natural diamond, it is easy to align diamond sticks to conform dressing direction to wear resistant direction. For reference, stick type dressers, which dressing direction is (110) <110> are denoted as "PD type", (211) <111> as PDX type.

Comparison of Dressing Performance

PD and PDX dressers with 4 placed pieces of 0.6x0.6x3.0mm3 (0.02cts x 4pcs.) synthetic diamond and a single point dresser with a single placed octahedron natural diamond (Appx.1/2ct.) were prepared. The grinding wheel was SN80N8V51S (silicon nitride wheel) sized φ405xφ152.4x50, and the dressing conditions were as follows: wheel speed: 32 m/sec, dressing infeed on rotation: 20μm/pass, traverse speed: 100μm/rev, and wet. Comparisons of wear volume of dresser and surface roughness are shown in *figure 5* and *figure 6*, respectively. Wear length of PD and PDX was low and wear rate was almost constant. Wear rate of PDX was little lower than that of PD reflecting the results of wear resistance in *figure 2*. On the other hand, wear length of single point dresser was large even though total crystal volume was much larger than that of PD/PDX. In addition, wear rate was unstable at the start of use because of small contact area. Surface roughness was also unstable in the single point dresser. When single point dresser was used surface roughness of grinding wheel was large at the start, getting smaller as dressing time increases, stabilized for a while, and reducing again. Then after 400 times dressing, it was unable to continue dressing test as the diamond fell off of the dresser. That result seems to be affected by the shape of a diamond included in the single point dresser. In PD and PDX dresser, surface roughness of the grinding wheel hardly changed regardless of dressing time as the dressers have stick shaped diamonds with constant crystal direction.

Comparison With Natural Multi-Point Dresser

A PD dresser with 3 pieces of 0.6x0.6x3.0mm3 (0.02cts x 3pcs.) synthetic diamond placed and a multi-point dresser with 40 pieces of natural diamond (1/90cts x 40pcs.) were prepared. The grinding wheel was GC#90 sized φ305xφ127x20, and the dressing conditions were as follows: wheel speed - 27 m/sec., dressing infeed on rotation - 30µm/pass, traverse speed - 200µm/rev and wet. Comparison of wear volume of dresser as a function of wear volume of grinding wheel is shown in *Figure 7*. Wear volume of diamond was proportional to wear volume of grinding wheel in every type of dresser. PD dresser showed smaller wear than the multiple-point dresser, even though total crystal volume of PD was much lower than that of natural multi-point dresser. Dressing resistance was also measured at the same time (*Figure 8*). Dressing resistance is one of the convenient criteria of dresser performance. In general, high dressing resistance lowers surface roughness of grinding wheel, and consequently, lowers the surface roughness or accuracy of the work to be ground. In the multi-point dresser dressing resistance was small in the beginning, and as dressing went on, the value rose and fluctuated because contact area on grinding wheel was not always the same due to crystal pullout. In the PD dresser, thrust force was very stable regardless of the dressing time, seemingly because, contact area of stick shaped diamonds on grinding wheel hardly changed.

Comparison With CVD Diamond Dresser

Lastly, comparison with CVD dresser was carried out. CVD diamond can be formed to be stick shaped, therefore crosssection area can be constant as wear progresses, as well as PD/PDX type. PD and CVD dressers with 1 piece of 0.8x0.8x3.0mm3 diamond were prepared. The grinding wheel was SN80N8V51S (silicon nitride wheel) sized φ405xφ127x50, and the dressing conditions were as follows: wheel speed - 45 m/sec, dressing infeed on rotation - 20µm/pass, traverse speed - 100µm/rev and wet. Comparison of wear length of diamond and dressing resistance are shown in *Figure 9* and *Figure 10*, respectively.

Wear resistance of CVD diamond was lower than that of PD type because CVD diamond is polycrystalline; therefore crystal orientation is rather random (*Photo 2* and *Photo 3*). Orientation and grain size depend on CVD conditions (gas concentration, temperature etc.). Dressing direction were both stable because of constant cross-section area, but dressing resistance of the CVD dresser was two times higher than that of the PD type.

The crystal dependence of diamond on wear resistance was measured and it was found that (110) <110> or (211) <111> were the most preferable directions for dresser,

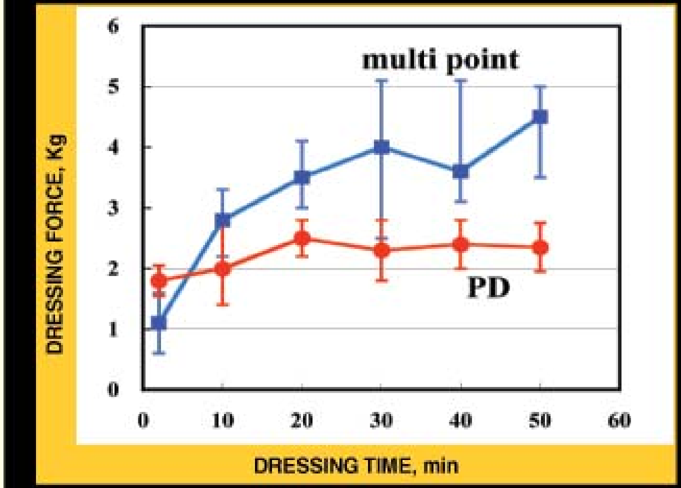

Figure 8 - Comparison of wear resistance between single point dresser and PD type dresser.

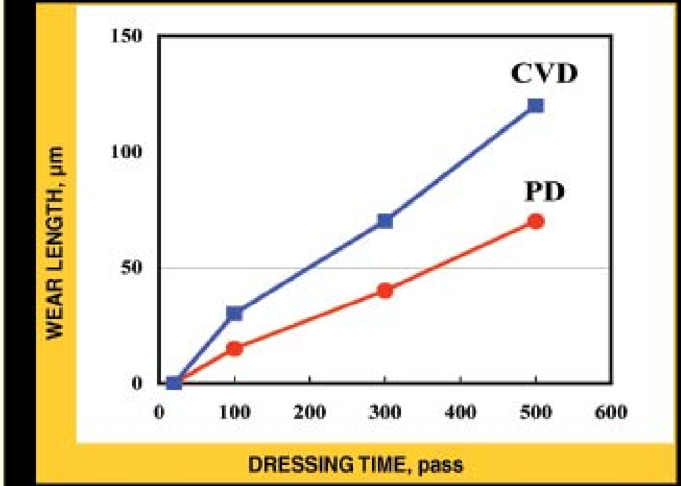

Figure 9 - Comparison of wear length between CVD dresser and PD type dresser.

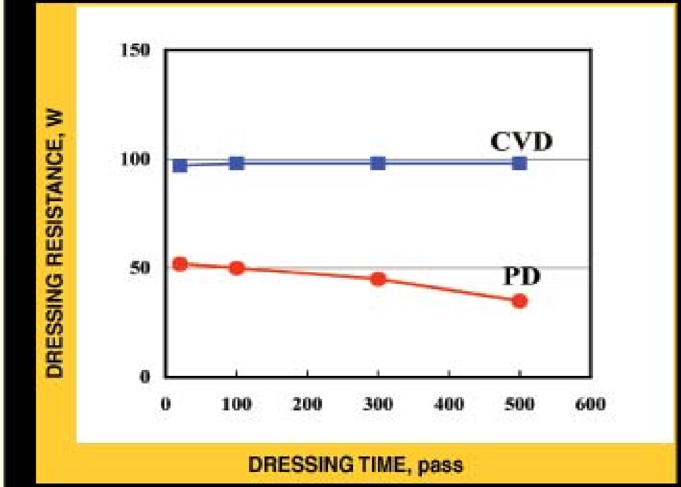

Figure 10 - Comparison of wear resistance between CVD dresser and PD type dresser.

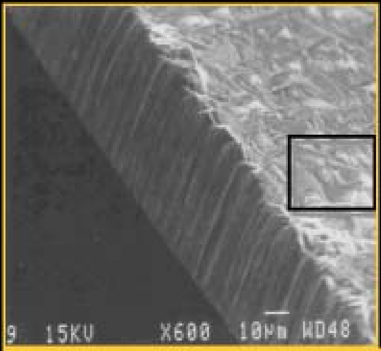

Photo 2 – CVD Diamond Columnar Structure

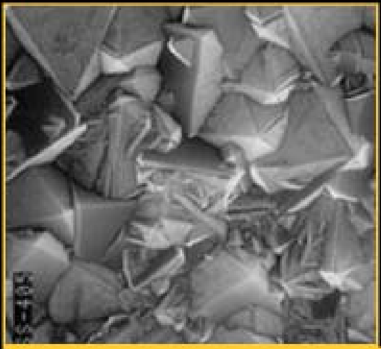

Photo 3 – (111) Oriented Structure

even though dressing direction in conventional dresser is (100) <110> in common usage. Based on these studies, a new type of diamond dresser was designed (Figure 11). The new diamond dresser is stickshaped and its dressing direction is (110) <110> or (211) <111>. Comparisons of dressing performance with conventional dressers were carried out and it was found that new designed dresser has following advantages:

- Wear rate is low because adopted direction is more resistant than conventional (100) <110>.
- Both wear rate and dressing resistance are stable because stick-shape assures that cross-section is constant and that there is no crystal pullout during use.

Consequently the newly designed dresser can make it possible to realize automation and cost saving in the grinding process. ■

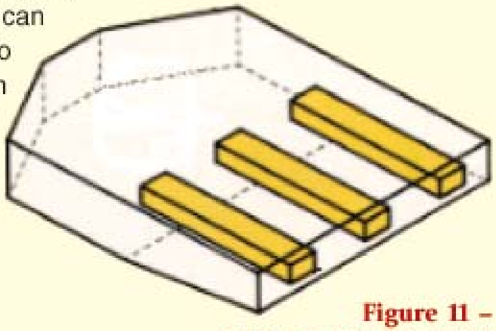

Figure 11 – New Diamond Dresser

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Which applies to your company: ______ Corporation ______ Partnership ______ Sole Proprietorship

Provide names of principle officers or partners: ______________________

When was your company established? __________

How long has your company been engaged in superabrasive/ultra-hard material industry? _______

List at least two business references, preferably one is an IDA member (name, company and address of each):

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CHECK APPROPRIATE MEMBERSHIP

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Any company and/or individual classified as a superabrasive/ultra-hard material supplier, tool maker, machine tool builder, end user or related business with offices in the USA, Canada or Mexico is eligible in this category. Only one individual shall be designated by each member company as the IDA Delegate with voting and other privileges described in the By-Laws.

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Available for companies having a principal office in the USA, Canada or Mexico, which are providing products or services to the superabrasive/ultra-hard material industry, but are not engaged in selling, using or dealing in industrial diamonds, cubic boron nitride, compacted diamond/cbn, diamond film or products containing diamonds/cbn. An Associate Member shall have all the privileges of regular membership, except that the delegate cannot vote at any membership meetings, participate in statistical reporting for the North American market, hold proxies or serve in any office in IDA. Annual fee for Associate Member is **$500 per year**.

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______ **Senior Membership**

Available for any individual who has retired or is no longer active in the diamond or cbn business, but wishes to receive information mailings and attend IDA meetings as a member. Annual fee for Senior Member is **$50 per year**.

WHAT IS THE IDA?

The Industrial Diamond Association of America, Inc. **is a non-profit trade association and was incorporated on March 29, 1946 in the State of New York. It is the oldest and most prestigious association in the superabrasive/ultrahard materials industry. Activity and focus has evolved from natural diamond to superabrasives and most recently, to all ultrahard materials including CVD Diamond. Members include material suppliers, tool manufacturers, component producers, machine tool builders, end users, academia/research affiliates and other companies related to the research, manufacture, application, use and sales of superabrasives.**

WHAT DOES THE IDA DO?

- Oversees Statistics Reporting Program
- Establishes Industry Standards
- Interacts With Global Associations And Organizations
- Creates And Distributes Market Studies & Data
- Organizes And Presents Technical Seminars & Conferences
- Serves As A Government Liaison For Industry Guidelines And Regulations
- Participates As Member Of World Diamond Council
- Provides Safety / Regulatory Reports And Advisement
- Resource For General Information And Consultation

OTHER MEMBER SERVICES

- PUBLISHES QUARTERLY MAGAZINE
- HOLDS ANNUAL CONVENTIONS
- HOSTS IDA WEBSITE WITH MEMBER FOCUS AND DIRECTION
- PROVIDES SPECIFIC ASSISTANCE ON INDIVIDUAL MEMBER ISSUES
- CREATES AND DISTRIBUTES PUBLICATIONS ON PRODUCTS AND APPLICATIONS
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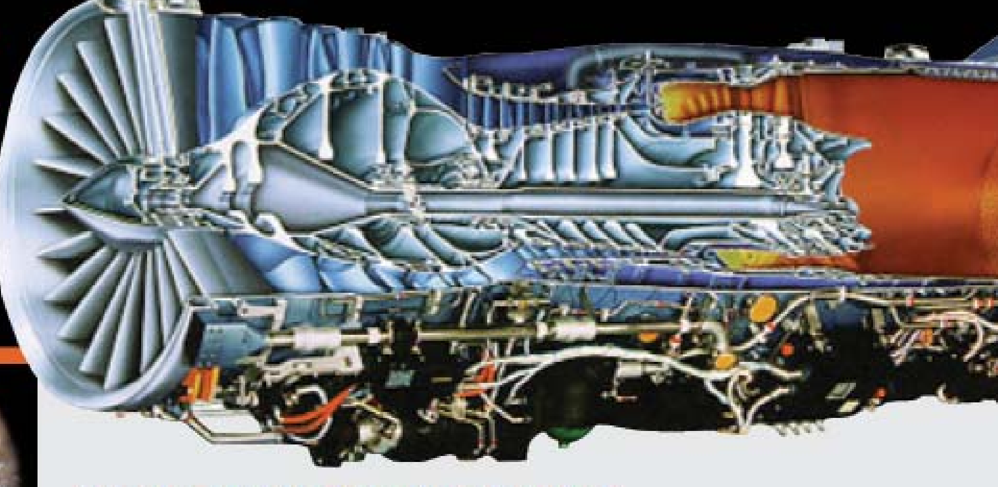
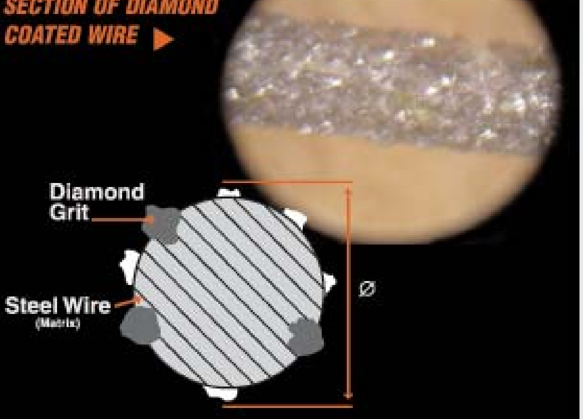
New Applications For Precision Saws Using Thin Diamond Wire for Material Testing

By WALTER EBNER, President – Well Diamond Wire Saws





SECTION OF DIAMOND COATED WIRE ▶

Diamond wire saws continue to make advances in automotive, aerospace and other areas to examine infrastructure, failure analysis or quality of critical components

▲ RECIPROCATING WIRE SAW

CONTINUOUS, ENDLESS WIRE SAW ◀

PHYSICAL LAW GOVERNS THE PROCESS OF CUTTING WITH A WIRE

The highly tensioned cutting wire will always cut straight, produce even surfaces and parallel slices in homogeneous materials. When non-homogeneous materials are cut some deviation may occur but the intrinsic force of mentioned physical law will always bring back the cutting wire into the straight line. Even with a simple law governing wire cutting, to produce an efficient working system requires much more skill and a lot of experience in order to get results. Many companies or individuals around the world have started building wire saws and only a few of them have survived. The cutting wire and the different parts of the saw must mate perfectly so that when sudden stress is put on the wire the tensioning device will absorb the additional force in order to avoid wire breaking.

COMPOSITION OF THE CUTTING WIRE AND TYPES OF SAWS

The core of the cutting wire is made of high tensile strength stainless steel of about 2000 N/square millimeter. The diameter of the thin wire is dependent on the size and the type of material of the sample and also on the saw type used, wires are available from around 100 to 700 microns or 0.10 to 0.70 mm. A proprietary process is used to put the diamonds around and into the wire, high pressure is used for this and no additional material is added in this process. Other superabrasives can be used, such as cubic boron nitride, but normally diamond gives the best results. Mesh size of the diamonds range between 10 and 60 microns depending on wire size. Diamond wires are manufactured to any length or welded in order to get a closed loop, depending of the type of saws used: the Reciprocating Saws or the Continuous, Endless Wire Saws.

RECIPROCATING WIRE SAWS

A coated wire up to 68 m of length, depending on the saw model used, is wound on a drum and is traveling back and forth all the time producing an axial motion which is used for cutting. Low wire speed (up to 2,5 m/sec) and high pressure between wire and workpiece (up to 5 kg) are very typical for this saw. All materials can be cut and no measurable heat is generated, making this saw a valuable tool for all work in R&D and Quality Control purposes. The advantages of this type of saw is there is very little surface damage on the part, in most cases no polishing required, there is minimum material loss, any material combination possible, there is no deformation of the sample with no micro cracks in sample.

CONTINUOUS, ENDLESS WIRE SAWS

These saws have been developed recently and offer new possibilities in wire cutting. High wire speed, 20 m/sec and more are very common and short cutting times are typical. Cooling of wire is recommended in order to optimize cutting parameters. Many different materials can be cut like glass, ceramics, semiconductors, etc, but these saws also cut soft materials like aluminum, PVC, "green" material known in the powder metallurgy and to some extent form cutting is possible. Since a welded wire is used, the wire diameter is slightly bigger than for reciprocating

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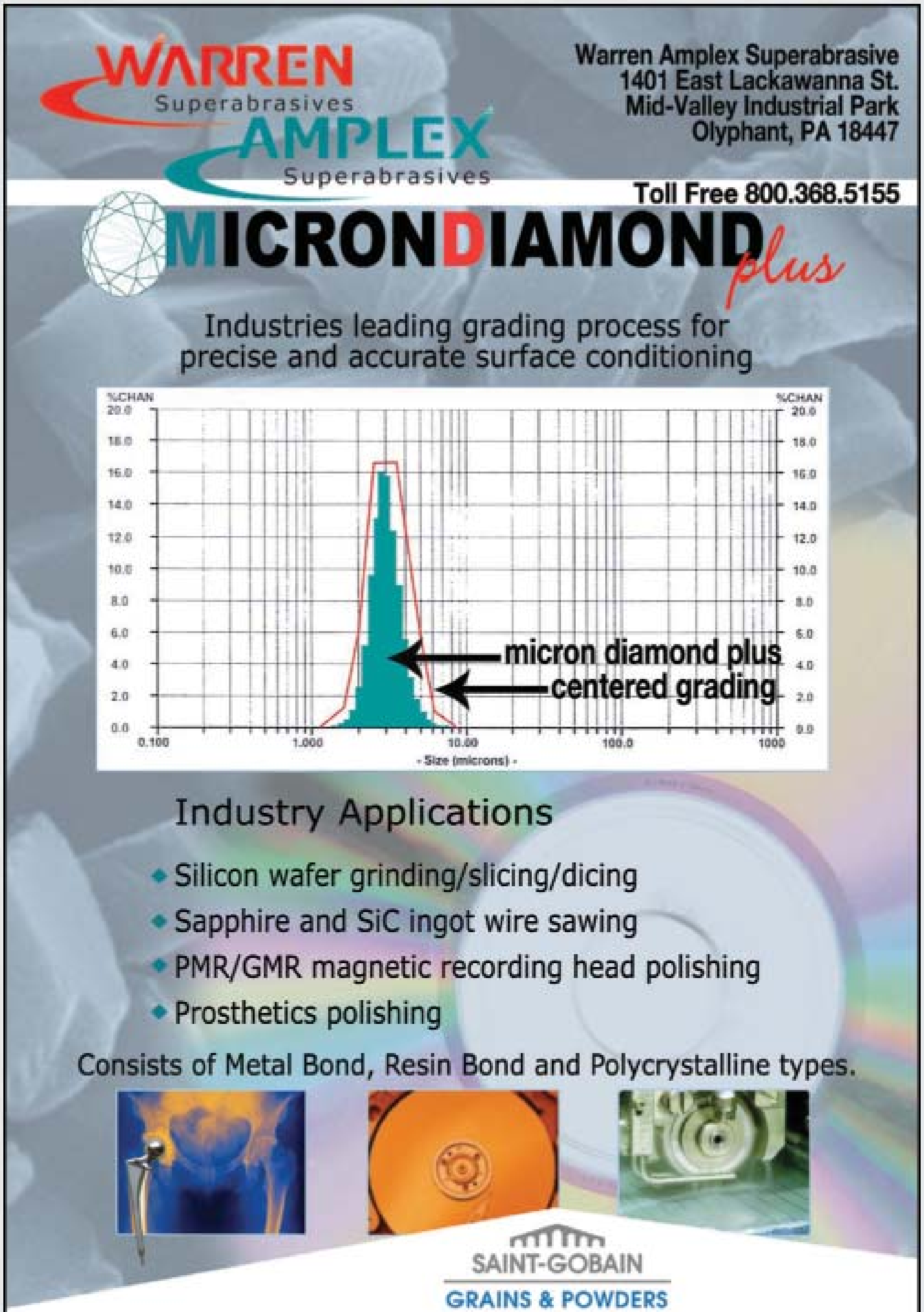
saws and ranges from 0.30 to 0.70 mm, depending on the application. As for all wire saws the diameter of the wheels are relatively big so that the wire dues not bend in the area known as plastic deformation of the wire but instead remains in the so-called elastic deformation. The advantages of this type of saw are high-speed cutting, sample can be hand held, form cutting is possible, quick wire change is an option and accidental contact with running wire does not produce skin injuries. Safety is very important in order to avoid injuries and for this reason alone wire saws are often the preferred choice when mechanical saws are needed, even though wire saws normally cut slower than other type of saws.

MANY APPLICATIONS FOR CRITICAL RESEARCH AND ANALYSIS

Because of the many advantages of wire saws, sample preparation in laboratories around the world is increasing with wire saws replacing disc saws in all fields like crystallography, archeology, metallurgy and microscopy in general. In addition wire saws are making inroads in medical research for anatomy, histology and pathology cutting through bones, tissues, teeth and implants, when thin slices of large samples are required. Wire saws are also featured in numerous micro technologies cutting small samples for tests such as, separating small electronic circuits for failure analysis and producing small pattern on any material. Quality control is another huge area for thin wire saws cutting through samples of any material composition by opening of components for optical inspection and measurement inside the component, such as cutting through bottles of glass or stoppers of any material together for controlling the sealing area or cutting through metallic sections of manufactured parts to detect flaws. Sampling in Medical Research Samples can also be cut and examined of competitors' products to gather information or quality comparisons. There is strong evidence that relatively big saws are needed for different larger applications. The diamond wire saw is often the only means to cut through big samples. Further advantages of diamond wire saws for many of these applications are: very little material loss, saws and equipment are easy to handle, the cutting does not contaminate the environment because it is a strictly mechanical process and no heat is involved, little power consumption, reasonable prices for saws. The scientific analytical use of the diamond wire saw continues to make advances in automotive, aerospace, medical and other critical areas where material samples must be obtained to examine infrastructure, composition, alloying or other research, failure analysis and quality verification of industrial components. ■



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Winter 2007/2008	Industry Review & Highlights	Nov. 30, 2007
Spring 2008	INTERTECH 2008 Preview & Superabrasives Resource Directory	Feb. 29, 2008
Summer 2008	INTERTECH Highlights	May 31, 2008
Fall 2008	CVD Diamond & cBN	Aug. 31, 2008
Winter 2008/2009	Industry Breakthroughs	Nov. 30, 2008

*Editorial topics subject to change

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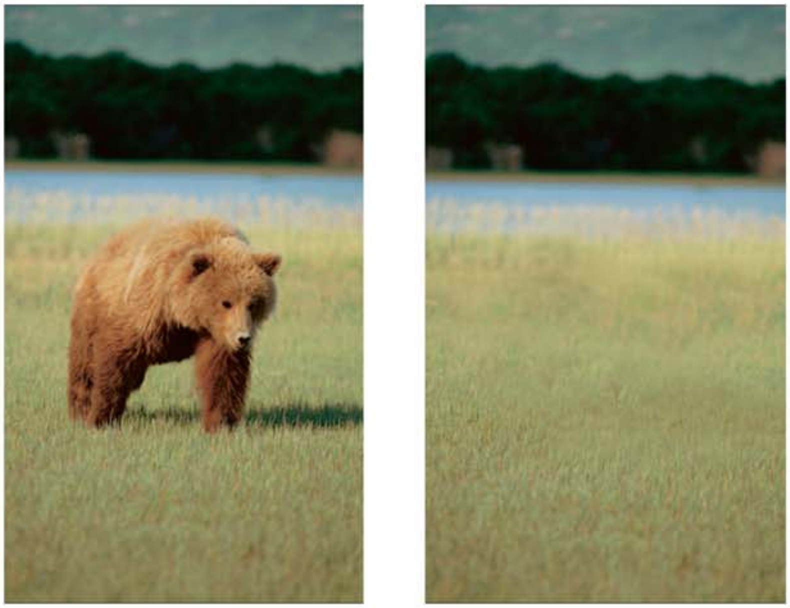

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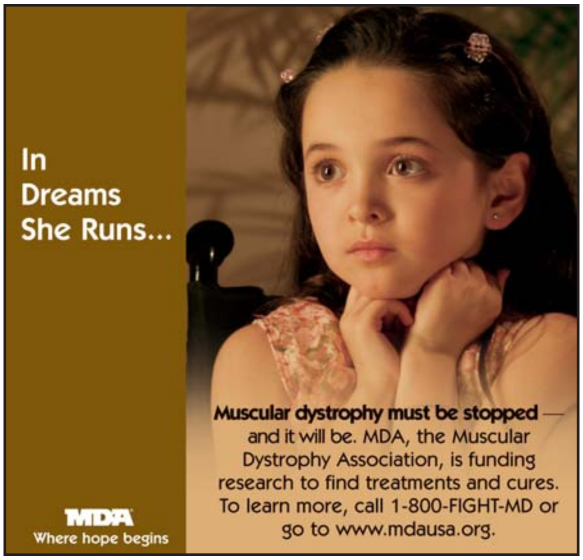
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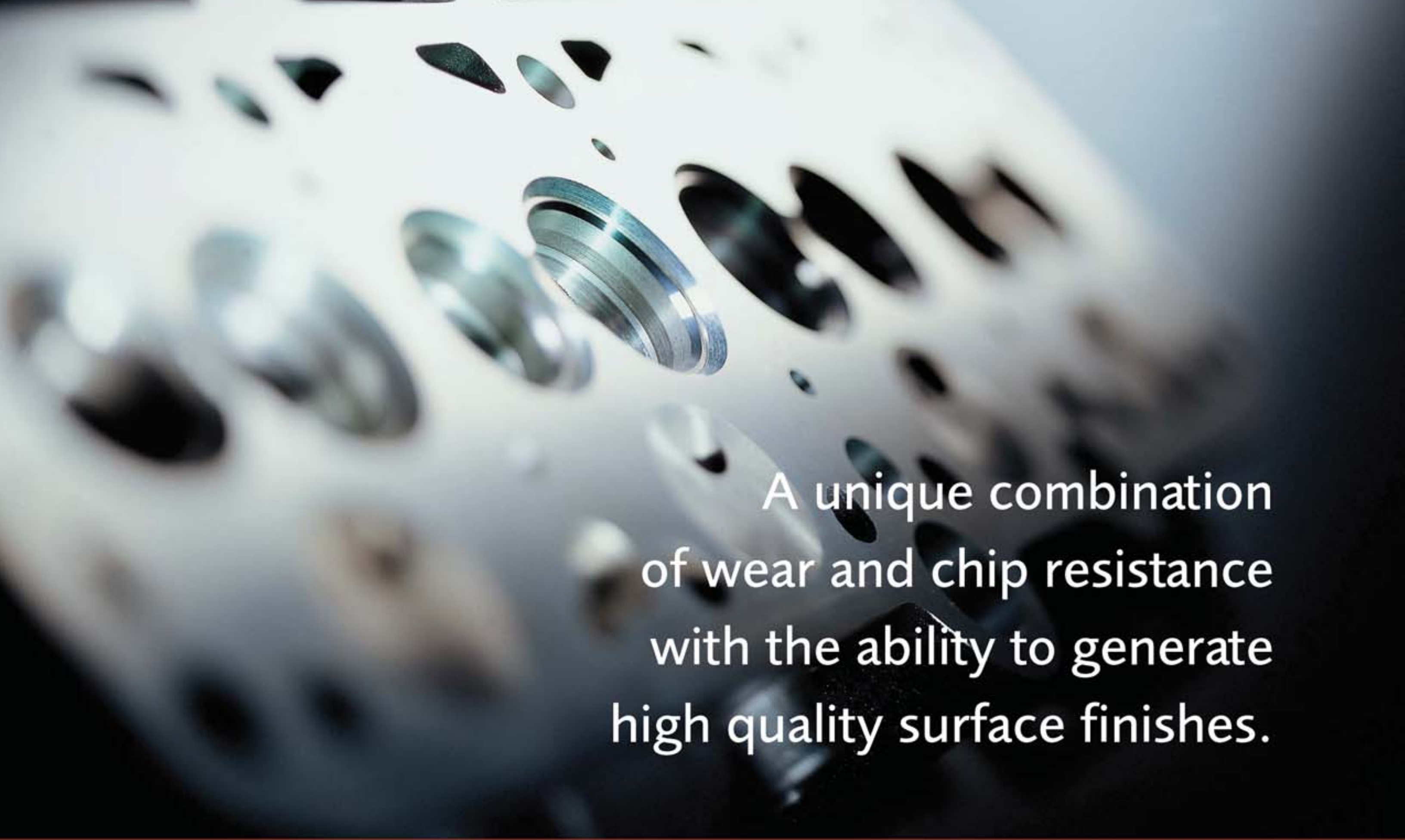

A unique combination
of wear and chip resistance
with the ability to generate
high quality surface finishes.

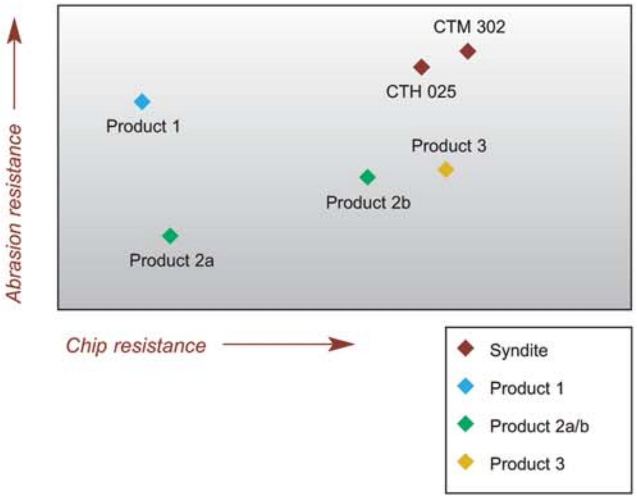
INTRODUCING A NEW GRADE OF PCD

Syndite CTM 302 has been developed for the metalworking industry with the specific purpose of having a grade with improved abrasion resistance, chip resistance and workpiece surface finish. The unique structure and properties of this material allows it to outperform all other competitive coarse grain materials. It also allows it to compete with medium grain competitor materials in terms of chip resistance and workpiece surface finish.

The graph opposite indicates the superior abrasion and chip resistance of **CTM 302** compared to other coarse grain materials.

CTM 302 is ideal for the machining of non ferrous metals, like silicon-aluminum alloys and metal matrix composites.

ABRASION RESISTANCE vs CHIP RESISTANCE



Diamond Abrasives Corporation

creative with all your cutting needs

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